TITLE: Continuous Pressure Decay test

TECHNICAL FIELD

The present invention relates to membranes filtration systems and more

5   particularly to testing the integrity of the porous hollow membranes used in such

systems.

BACKGROUND OF THE INVENTION

Porous membrane filtration systems require regular backwashing

of the membranes to maintain filtration efficiency and flux while reducing

10   transmembrane pressure (TMP) which rises as the membrane pores become

clogged with impurities. Typically, during the backwash cycle the impurities are

forced out of the membrane pores by pressurised gas, liquid or both into the

feed tank or cell. The liquid containing impurities and deposits from the

membranes is then drained or flushed from the tank.

15   As stated above, during the backwash of membranes it is usual to include

a liquid backwash. Typically a pump is used to drive the liquid back through the

membrane pores, however, it has been found that gas pressure can be used as

an alternative to the pump to provide the driving force for pushing the liquid back

through the membrane pores. In this case it is possible to empty all the liquid

20   within the membrane through the membrane walls leaving the membrane

lumens filled with gas. One advantage of such a backwash is that all parts of

the membrane will experience the liquid backwash at the pressure of the applied

gas as the liquid/gas interface moves along the membrane. This is particularly

an advantage for a membrane where the filtrate is withdrawn from one end of

25   the membrane only.

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Prior art integrity testing is typically carried out every 4 to 24 hours as it takes 10 minutes or more to conduct accurately and so is not considered a continuous test. More frequent testing is not practical as the downtime is too great. The concern in the water industry is that if the membranes fail badly

5 between tests, poor water quality could be produced and may be sent to customers for some hours before the next integrity test identifies the problem.

It is thus desirable to have an integrity test which can be conducted in a very short time frame and on a regular basis. Using only a short time interval over which to measure the integrity of the membranes is less accurate but has

10 been found to be sufficient to detect significant changes in integrity, thereby ensuring that a minimum level of integrity is maintained at all times.

The backwash is the most likely time that fibre damage is to occur as it is the most aggressive step on the membrane. It is thus desirable that integrity testing is conducted as the last stage of the backwash and confirms the integrity

15 of the membranes just before returning to filtration. Any significant damage resulting from the backwash will thus be detected.

SUMMARY OF THE INVENTION

It has been discovered that with the form of backwash described above it is

20 now possible to carry out an integrity test using the pressure decay test method as part of the backwash process. This provides many of the desired advantages while overcoming or at least ameliorating one or more of the disadvantages described above.

The pressure decay method tests the integrity of hollow porous

25 membranes by applying pressurized gas at a test pressure to both sides of the

membrane wall, releasing the pressure on one side of the wall and then

measuring the pressure decay on the other side of the wall. The measured

pressure decay is directly related to the flow of gas across the membrane wall

assuming no leaking valves. A larger-than-expected flow indicates a lack of

5   membrane integrity.

According to one aspect, the present invention provides a method of

testing the integrity of permeable hollow membranes used for filtering solids

from a liquid suspension including:

(i)   providing a pressure differential across the walls of permeable,

10   hollow membranes immersed in the liquid suspension, said liquid suspension

being applied to the outer surface of the porous hollow membranes to induce

and sustain filtration through the membrane walls wherein:

(a)   some of the liquid suspension passes through the walls of the

membranes to be drawn off as permeate from the hollow

15   membrane lumens, and

(b)   at least some of the solids are retained on or in the hollow

membranes or otherwise as suspended solids within the liquid

surrounding the membranes,

(ii)   backwashing the membrane pores by applying a gas at a pressure

20   below the bubble point to liquid permeate within the membrane

lumens to displace the liquid permeate within the lumens through

the membrane pores,

(iii)   performing an integrity test on the membranes by

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    a. allowing the gas pressure on the lumen side of the membrane

        walls to increase to a predetermined level above the pressure on

        the other side of the membrane walls,

    b. isolating the lumen side of the membranes,

5   c. measuring the reduction in gas pressure on the lumen side of the

        membrane walls resulting from gas passing through the

        membrane walls over a predetermined period,

    d. comparing the measured reduction in pressure against a

        predetermined value to determine the integrity of said

10   membranes,

    (iv)   refilling membrane lumens with liquid, and

    (v)   recommencing said filtration through the membrane walls.

The advantage of this method of testing and backwashing is that the

preliminary part of the pressure decay test – filling the membrane lumen with

15 gas – and the final part – refilling the lumen with liquid – are already carried out

as part of the backwash process. This results in the allowed time for the

pressure decay test and the system "down time" to be significantly reduced.

Further, if it is only required to test the membrane at an integrity corresponding

to a Logarithmic Reduction Value (LRV) of 4, the integrity test can be very short

20 – typically about 30 seconds to one minute. Where "downtime" needs to be

short, a reasonably accurate integrity test can be performed in 5 to 10 seconds.

As this integrity test could be carried out with every backwash of the

membranes it can reasonably be described as continuous. However, it will be

appreciated that longer test times can be used for greater accuracy at the

25 expense of increased downtime. The integrity test may also be carried on every

second or third backwash as a compromise between further reducing the

downtime and increasing the test frequency.

It will be appreciated that further embodiments and exemplifications of the

invention are possible without departing from the spirit or scope of the invention

5   described.